

**APPLICATION FOR UNITED STATES
LETTERS PATENT**

by

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for

**SECURITY POLICY MANAGEMENT
FOR NETWORK DEVICES**

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SECURITY POLICY MANAGEMENT FOR NETWORK DEVICES

FIELD OF THE INVENTION

5 The present invention is directed to a distributed network having multiple servers and other devices that are provisioned or configured for support and hosting of sites and/or resources on the Internet, intranets, and other communications networks. More particularly, the present invention is directed to a system and methods for using machine-readable descriptions of established
10 policies and information stored in one or more databases to provision login accounts on multiple computing devices within a network.

BACKGROUND OF THE INVENTION

 The growing popularity and increasing accessibility of the Internet has resulted in its becoming a major source of information, as well as a vehicle for
15 inter-party transactions, in a variety of environments. For instance, a number of different types of entities, from government agencies to school systems and other organized groups, host Internet and/or intranet websites that provide information about themselves and topics related to their interests. Similarly, commercial enterprises employ websites to disseminate information about their products or
20 services, as well as conduct commercial transactions, such as the buying and selling of goods. To support these activities, each website requires an infrastructure that stores the information provided by that site, responds to user requests for the information, and conducts other types of transactions appropriate to the site. A significant component of this infrastructure is a web server, which
25 receives requests for information, retrieves it from the appropriate sources, and provides it to the requestor. Websites which provide more complex services, such

as on-line ordering, may also include application servers to support each additional function.

In the case of a relatively small entity, the infrastructure to support a website may be as simple as a single server, or even a portion of the server.

5 Conversely, a large popular website that consists of several thousand pages of information and that is accessed quite frequently may require numerous servers to provide the necessary support. Similarly, websites for commercial entities, through which transactional operations are conducted, may employ multiple application servers to support transactions with a large number of customers at a
10 time.

While an entity may create and support its own "website", some entities may desire to have their websites supported by an organization that specializes in such a service, such as a managed service provider. In such a situation, employees of the various entities may require access to the servers and other devices that
15 support their respective websites, for example to update content, perform routine maintenance, etc. At the same time, personnel at the support organization also require access to these devices, to upgrade, reconfigure or retire components of the infrastructure. When a single organization is responsible for supporting the data of multiple entities, and different groups of people require access to that data, a
20 problem may arise in supporting the individual needs of each of the various entities. For example, each of the respective entities can have specific policies or procedures with regard to their respective information. For example, security policies may be established which define who has permission to access what information. Such a security policy can establish that a particular individual has
25 the authority to access all devices associated with a particular entity, whereas other individuals such as developers may only be authorized access to a subset of the devices associated with the entity.

Prior to the present invention, a common solution was to manually configure each device. For example, each device was configured with access lists

or user-password pairs which identified who had access to the device. This solution, while providing some data security, has its limitations. For example, when the system requires updating, it can be difficult to find all of the instances of, for example, the user-password pairs, leaving the system vulnerable to unauthorized access. Furthermore, the infrastructure required to support large websites may include numerous computing devices, such as web servers, database servers, and application servers, resulting in significant efforts in maintaining the current data.

Accordingly, it is desirable to provide a system and method for configuring computing devices within the context of a multi-party communications network that provides sufficient flexibility to accommodate the different needs of each of the entities who provide services by way of the network, while providing the ability to update the needs of each entity as they change.

SUMMARY OF THE INVENTION

In accordance with the present invention, the foregoing objectives are achieved by means of machine-readable descriptions, identified herein as account templates, which represent policies applicable to all of the computing devices within a network, policies applicable to only a subset of the computing devices, and/or policies applicable to an individual computing device within the network.

These and other features of the invention are explained in greater detail hereinafter with reference to an exemplary embodiment of an invention illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an overview of an environment in which an embodiment of the invention can be implemented;

Figure 2 is a block diagram of one embodiment of a hardware configuration for a web site in a data center;

Figure 3 is a block diagram of a provisioning framework in which an embodiment of the invention can be implemented; and

Figures 4a-4b are flow diagrams describing the creation and implementation of templates according to an embodiment of the present invention.

5 **DETAILED DESCRIPTION**

To facilitate an understanding of the principles of the present invention, it is described hereinafter with reference to its application in a computer network, of a type wherein a support organization (such as a managed service provider, or MSP) provides the infrastructure and support for websites and other network
10 resources of multiple entities, referred to hereinafter as customers. For additional discussion of such a network, reference is made to co-pending, commonly assigned Application No. 09/841,008, filed on April 25, 2001, the disclosure of which is incorporated herein by reference.

The present invention is herein described with reference to the
15 implementation of security polices, more specifically to definition of who is authorized to access what devices. It will be appreciated, however, that the implementation of the invention that is described hereinafter is merely exemplary, and that the invention can find practical application in any environment where a policy structure is established for multiple computing devices within the network.

Figure 1 is an overview of an environment in which an embodiment of the present invention can be implemented. A data center 28 is partitioned into multiple customer compartments 29, each of which may be arranged as shown in Figure 2. This exemplary configuration comprises two outer racks 26a and 26c of servers which implement the business logic of a customer's web site, and a central
20 rack 26b of network devices which connect the servers to the outside world. Returning to Figure 1, each compartment is connected to a backbone 30 or similar type of common communication line for access by computers which are external to the data center. For instance, if the compartments are associated with Internet web

sites, the backbone 30 constitutes the physical communication path via which end users access those sites over the Internet. The backbone may also form the path via which the web site hosts can securely communicate with the devices in their individual compartments, for instance by virtual private networks.

5 Also located in the data center 28 is a provisioning and management network 31. This network is connected to the computing devices in each of the compartments 29 which are to be managed. The provisioning network 31 is illustrated in Figure 1 as being connected to the compartments 29 by a network which is separate from the backbone 30; however, the provisioning network can
10 alternatively communicate with the compartments over the backbone, using a secure communications protocol.

 The provisioning network 31 may be operated by the owner of the data center, or by a third-party MSP. While Figure 1 illustrates all of the compartments being connected to the network 31, this need not be the case. To
15 this end, multiple provisioning networks may be located in the data center, with each one operated by a separate entity to provision and manage the devices in different ones of the compartments 29. In accordance with the present invention, the network 31 automatically controls the provisioning and management of the computing devices in each compartment associated with that network.

20 To automate the provisioning of servers and related types of devices, an agent is installed on each device that is controlled by the network 31, to handle the retrieval and loading of software onto the device. The agent communicates with the provisioning network 31 to obtain commands regarding tasks that need to be performed on its device, as well as obtain the software components that are to be
25 installed as part of the provisioning process.

 One example of a provisioning network 31 that communicates with the agents on individual devices, to perform automated provisioning, is illustrated in Figure 3. Two fundamental functions are implemented by the provisioning network. One of these functions is to maintain information about, and manage, all

of the devices that are associated with the provisioning system. The second function is to store and provide the software that is loaded on these devices. The first function is implemented by means of a central database 32, that is accessed via a database server 33. This database comprises a repository of all pertinent information about each of the devices that are connected to the provisioning network. Hence, depending upon the extent of the provisioning system, the central database might contain information about devices in only a few web site compartments, or an entire data center, or multiple data centers. The information stored in this database comprises all data that is necessary to provision a device. For instance, it can include the hardware configuration of the device, e.g., type of processor, amount of memory, interface cards, and the like, the software components that are installed on the device along with the necessary configuration of each of those components, and logical information regarding the device, such as its IP address, the web site with which it is associated, services that it performs, etc. For a detailed discussion of an exemplary model of such a database for storing all of the relevant information, reference is made to co-pending Application No. 09/699,353, filed on October 31, 2000, the disclosure of which is incorporated herein by reference. In essence, the information stored in the database constitutes a model for each device that is managed by the provisioning system, as well as the interconnection of those devices.

To further enhance the security of the communications between the provisioning network and the agents, the network includes a central gateway 38 for communications. The gateway 38 functions as the focal point for all communications, and converts the policies established through the user interface into the appropriate primitives to implement the provisioning process, by means of SQL statements to the database and XML-RPC messages to the remote agents 36 on the devices. By separating the process considerations entered by management personnel from the basic level operation, these two aspects of provisioning can be individually customized and revised, as desired.

According to an exemplary embodiment of the invention, three levels or categories of templates are created (global, customer, and server) in order to allow the support organization the flexibility to implement its security policies as well as the policies of the individual customers. A global template is created in order to reflect the policies of the support organization i.e., policies which are applicable to all the devices maintained by the provisioning network. For example, a global security policy may indicate that certain individuals or groups of individuals have access to all the devices supported by the network or that all database servers are accessible by the database administrator.

Customer templates are created in order to reflect the policies of a particular customer i.e., policies which only affect a subset of the devices maintained by the provisioning network. For example, the security policy of a particular customer may indicate that certain individuals or managers have access to historical or financial data, or that web developers have access to web servers but not database servers. The customer template, like the server template discussed below, usually augments the global template; however, a flag can be set to indicate that the global template is not to be inherited.

Server templates are created in order to further augment the customer template by reflecting policies which are applicable to a particular type of device within a customer compartment, e.g., a database, web server, or application server.

As mentioned above, the customer template usually augments the global template, i.e., the customer template inherits the global policies. This results in there generally being one global policy, for example, for access security, and additional access security policies for each customer and/or device, wherein the customer template inherits the global template policies and the server templates inherits the customer template policies. However, certain customers may not wish to implement the global policy or a global policy may conflict with a customer-specific policy. Therefore, the present invention provides the ability to disable the

inheritance feature. This is achieved by setting a meta-flag to disable the inheritance feature. For example, the flag can simply set an inherit users/groups state to true or false. In addition to disabling the inherit feature in the customer template, the feature may also be disabled in the server template as well.

- 5 Accordingly, the present invention provides flexibility at both the customer and device level.

Each level or category of template described above is created with the same structure, differing only in the policies which they reflect. For example, a template reflecting security policies can define (1) a specific user or group, (2) a pointer to external information which defines a list of users or a role, and/or (3) conditional statements. Therefore, the data structure of an exemplary security policy template is as follows.

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15      <accounttemplate>
          <user>
              <uid> ggood </uid>
              <gecos> Gordon Good </gecos>
              <uidnumber> 5725 </uidnumber>
              <gidnumber> 1002 </gidnumber>
              <home directory> /home/ggood </homedirectory>
20              <userpassword xform="CRYPT"> *LK* </userpassword>
              <loginshell> /bin/csh </loginshell>
          </user>
          <extuser> uid=sean, ou=people, o=abcinc.com </ext user>
          < if name ="SERVICE" value="DATABASE">
25              <extrole> cn=ABCInc DBAm ou=roles,o=abcinc.com </extrole>
          </if>
      </accounttemplate>
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30 The ability to define external users or roles allows the template to point to a source external to the template which provides information during expansion of the template. For example, if a template points to the external role of developer, then only a single list of all individuals assigned the role of developer need be created and maintained, for example in the database 32. Accordingly, if an individual

changes positions (roles) or leaves the company, only the list of individuals assigned as developers need be updated.

5 The ability to establish conditionals in the template provides flexibility in defining the policies the template is to reflect. For example, assume that the security policy of the support organization states (1)that two particular users, Gordon and Paul are to have access to all devices maintained by the provisioning network, (2) all database servers are to be accessible by the database administrator, (3) all system developers are to have access to the devices maintained by the Host, and (4) all account representatives are to have access to the devices associated with their respective customers. Prior to the present invention, each device would have to be manually configured to allow access to Gordon, Paul, and to every individual assigned the role of developer. In addition, it would have to be determined, for each device, whether or not the database administer or an account manager should have access. Further, should there be a change, for example a new database
10 administer is hired or an account manager changes, each device would have to be updated. However, according to the present invention, a single global template is created which defines Paul and Gordon as specific users, developers as an external role, and the database administrator and the account developers as conditionals. Accordingly, the list of individual developers need only be input
15 once at the location specified in the template.
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Figure 4a and 4b illustrate flow charts associated with the creation and use of templates in accordance with the present invention. As shown in Figure 4a, a global template reflecting the policies applicable to all devices with in the network is created at step 402. At step 404, customer templates, or templates representing policies applicable to a subset of the devices is defined. Finally, at step 406,
25 server templates, or templates reflecting policies applicable to certain types of devices are defined.

During provisioning of a device or in order to update the account information, the templates are expanded to create an XML document which

contains, for example, the access lists as shown in Figure 4b. At step 408, the global template is expanded and any external data is retrieved. Then at step 410, the customer template is expanded if applicable as is the server template at step 412. An XML document containing the expanded information is created, at step 414 and sent to each device. The agent resident on each respective device receives the XML document and interprets the information for its specific platform, for example Unix, Solaris etc., at step 418.

The present invention exhibits various advantages. For example, the account template is not directly accessed by each of the customer compartments or each server, but rather account information is sent to each provisioned device, by way of expanded information, which makes a copy and stores the account information locally. This allows the provisioned device to respond to login requests autonomously, without involvement of the provisioning services. This avoids delays or denials of access if there is congestion or malfunction in the communication path between any of the devices and the communication gateway. Additionally, the centrality of the account template, and expanding the information in the individual devices, allows for a support organization to change the account template at a single location, and the changes are distributed by way of expansion within the customer devices.

The foregoing description has been provided in the context of a system and method for providing account management within a network having the ability for automated provisioning, maintenance, and configuration of servers connected to a communication network. It will be appreciated by those of ordinary skill in the art that the present invention can be embodied in other forms without departing from the spirit or characteristics thereof. For instance, while an exemplary embodiment of the present invention has been described in the context of having a single host data server, it is fully contemplated that multiple host data centers could be employed using the system and method of the present invention. In such a system, multiple host data centers communicate with a single location that stores the master

policy and directory structure. Precautions are taken to ensure that each host data center would have an up-to-date version of the directory structure contained within the central master directory structure data center.

5 The foregoing description is, therefore, considered in all aspects to be illustrative and not restrictive. The scope of the invention is indicated by the following claims and all changes that come within the meaning and range of equivalents are therefore intended to be embraced therein.

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